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So what if I could make for you a designer baby? What if you as a parent-to-be and I as a scientist decided to go down that road together?

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What if we didn't? What if we thought, "That's a bad idea," but many of our family, friends and coworkers did make that decision?

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Let's fast-forward just 15 years from now. Let's pretend it's the year 2030, and you're a parent. You have your daughter, Marianne, next to you, and in 2030, she is what we call a natural because she has no genetic modifications. And because you and your partner consciously made that decision, many in your social circle, they kind of look down on you. They think you're, like, a Luddite or a technophobe.

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Marianne's best friend Jenna, who lives right next door, is a very different story. She was born a genetically modified designer baby with numerous upgrades. Yeah. Upgrades. And these enhancements were introduced using a new genetic modification technology that goes by the funny name CRISPR, you know, like something's crisp, this is CRISPR. The scientist that Jenna's parents hired to do this for several million dollars introduced CRISPR into a whole panel of human embryos. And then they used genetic testing, and they predicted that that little tiny embryo, Jenna's embryo, would be the best of the bunch. And now, Jenna is an actual, real person. She's sitting on the carpet in your living room playing with your daughter Marianne. And your families have known each other for years now, and it's become very clear to you that Jenna is extraordinary. She's incredibly intelligent. If you're honest with yourself, she's smarter than you, and she's five years old. She's beautiful, tall, athletic, and the list goes on and on. And in fact, there's a whole new generation of these GM kids like Jenna. And so far it looks like they're healthier than their parents' generation, than your generation. And they have lower health care costs. They're immune to a host of health conditions, including HIV/AIDS and genetic diseases.

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It all sounds so great, but you can't help but have this sort of unsettling feeling, a gut feeling, that there's something just not quite right about Jenna, and you've had the same feeling about other GM kids that you've met. You were also reading in the newspaper earlier this week that a study of these children who were born as designer babies indicates they may have some issues, like increased aggressiveness and narcissism. But more immediately on your mind is some news that you just got from Jenna's family. She's so smart, she's now going to be going to a special school, a different school than your daughter Marianne, and this is kind of throwing your family into a disarray. Marianne's been crying, and last night when you took her to bed to kiss her goodnight, she said, "Daddy, will Jenna even be my friend anymore?"

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So now, as I've been telling you this imagined 2030 story, I have a feeling that I may have put some of you into this sci-fi frame of reference. Right? You think you're reading a sci-fi book. Or maybe, like, in Halloween mode of thinking. But this is really a possible reality for us, just 15 years from now.

04:04

I'm a stem cell and genetics researcher and I can see this new CRISPR technology and its potential impact. And we may find ourselves in that reality, and a lot will depend on what we decide to do today. And if you're still kind of thinking in sci-fi mode, consider that the world of science had a huge shock earlier this year, and the public largely doesn't even know about it. Researchers in China just a few months ago reported the creation of genetically modified human embryos. This was the first time in history. And they did it using this new CRISPR technology. It didn't work perfectly, but I still think they sort of cracked the door ajar on a Pandora's box here. And I think some people are going to run with this technology and try to make designer babies.

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Now, before I go on, some of you may hold up your hands and say, "Stop, Paul, wait a minute. Wouldn't that be illegal? You can't just go off and create a designer baby." And in fact, to some extent, you're right. In some countries, you couldn't do that. But in many other countries, including my country, the US, there's actually no law on this, so in theory, you could do it. And there was another development this year that resonates in this area, and that happened not so far from here over in the UK. And the UK traditionally has been the strictest country when it comes to human genetic modification. It was illegal there, but just a few months ago, they carved out an exception to that rule. They passed a new law allowing the creation of genetically modified humans with the noble goal of trying to prevent a rare kind of genetic disease. But still I think in combination these events are pushing us further towards an acceptance of human genetic modification.

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So I've been talking about this CRISPR technology. What actually is CRISPR? So if you think about the GMOs that we're all more familiar with, like GMO tomatoes and wheat and things like that, this technology is similar to the technologies that were used to make those, but it's dramatically better, cheaper and faster.

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So what is it? It's actually like a genetic Swiss army knife. We can pretend this is a Swiss army knife with different tools in it, and one of the tools is kind of like a magnifying glass or a GPS for our DNA, so it can home in on a certain spot. And the next tool is like scissors that can cut the DNA right in that spot. And finally we have a pen where we can literally rewrite the genetic code in that location. It's really that simple.

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And this technology, which came on the scene just three years ago, has taken science by storm. It's evolving so fast, and it's so freaking exciting to scientists, and I admit I'm fascinated by it and we use it in my own lab, that I think someone is going to go that extra step and continue the GM human embryo work and maybe make designer babies. This is so ubiquitous now. It just came on the scene three years ago. Thousands of labs literally have this in hand today, and they're doing important research. Most of them are not interested in designer babies. They're studying human disease and other important elements of science. So there's a lot of good research going on with CRISPR. And the fact that we can now do genetic modifications that used to take years and cost millions of dollars in a few weeks for a couple thousand bucks, to me as a scientist that's fantastic, but again, at the same time, it opens the door to people going too far. And I think for some people the focus is not going to be so much on science. That's not what's going to be driving them. It's going to be ideology or the chase for a profit. And they're going to go for designer babies.

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So why should we be concerned about this? We know from Darwin, if we go back two centuries, that evolution and genetics profoundly have impacted humanity, who we are today. And some think there's like a social Darwinism at work in our world, and maybe even a eugenics as well. Imagine those trends, those forces, with a booster rocket of this CRISPR technology that is so powerful and so ubiquitous. And in fact, we can just go back one century to the last century to see the power that eugenics can have.

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So my father, Peter Knoepfler, was actually born right here in Vienna. He was Viennese, and he was born here in 1929. And when my grandparents had little baby Peter, the world was very different. Right? It was a different Vienna. The United States was different. The world was different. There was a eugenics rising, and my grandparents realized, pretty quickly I think, that they were on the wrong side of the eugenics equation. And so despite this being their home and their whole extended family's home, and this area being their family's home for generations, they decided because of eugenics that they had to leave. And they survived, but they were heartbroken, and I'm not sure my dad ever really got over leaving Vienna. He left when he was just eight years old in 1938.

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So today, I see a new eugenics kind of bubbling to the surface. It's supposed to be a kinder, gentler, positive eugenics, different than all that past stuff. But I think even though it's focused on trying to improve people, it could have negative consequences, and it really worries me that some of the top proponents of this new eugenics, they think CRISPR is the ticket to make it happen.

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So I have to admit, you know, eugenics, we talk about making better people. It's a tough question. What is better when we're talking about a human being? But I admit I think maybe a lot of us could agree that

human beings, maybe we could use a little betterment. Look at our politicians here, you know, back in the US -- God forbid we go there right now. Maybe even if we just look in the mirror, there might be ways we think we could be better. I might wish, honestly, that I had more hair here, instead of baldness. Some people might wish they were taller, have a different weight, a different face. If we could do those things, we could make those things happen, or we could make them happen in our children, it would be very seductive. And yet coming with it would be these risks. I talked about eugenics, but there would be risks to individuals as well. So if we forget about enhancing people and we just try to make them healthier using genetic modification, this technology is so new and so powerful, that by accident we could make them sicker. That easily could happen. And there's another risk, and that is that all of the legitimate, important genetic modification research going on just in the lab -- again, no interest in designer babies -- a few people going the designer baby route, things go badly, that entire field could be damaged.

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I also think it's not that unlikely that governments might start taking an interest in genetic modification. So for example our imagined GM Jenna child who is healthier, if there's a generation that looks like they have lower health care costs, it's possible that governments may start trying to compel their citizens to go the GM route. Look at China's one-child policy. It's thought that that prevented the birth of 400 million human beings. So it's not beyond the realm of possible that genetic modification could be something that governments push. And if designer babies become popular, in our digital age - viral videos, social media -- what if designer babies are thought to be fashionable, and they kind of become the new glitterati, the new Kardashians or something?

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(Laughter)

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You know, are those trends that we really could control? I'm not convinced that we could.

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So again, today it's Halloween and when we talk about genetic modification, there's one Halloween-associated character that is talked about or invoked more than anything else, and that is Frankenstein. Mostly that's been Frankenfoods and all this other stuff. But if we think about this now and we think about it in the human context on a day like Halloween, if parents can in essence costume their children genetically, are we going to be talking about a Frankenstein 2.0 kind of situation? I don't think so. I don't think it's going to get to that extreme. But when we are going about hacking the human code, I think all bets are off in terms of what might come of that. There would still be dangers. And we can look in the past to other elements of transformative science and see how they can basically go out of control and permeate society.

13:57

So I'll just give you one example, and that is in vitro fertilization. Almost exactly 40 years ago, test tube baby number one Louise Brown was born, and that's a great thing, and I think since then five million IVF babies have been born, bringing immeasurable happiness. A lot of parents now can love those kids. But if you think about it, in four decades, five million babies being born from a new technology is pretty remarkable, and the same kind of thing could happen with human genetic modification and designer babies. So depending on the decisions we make in the next few months, the next year or so, if designer baby number one is born, within a few decades, there could well be millions of genetically modified humans. And there's a difference there too, because if we, you in the audience, or I, if we decide to have a designer baby, then their children will also be genetically modified, and so on, because it's heritable. So that's a big difference.

15:03

So with all of this in mind, what should we do? There's actually going to be a meeting a month from tomorrow in Washington, D.C. by the US National Academy of Sciences to tackle that exact question. What is the right path forward with human genetic modification? I believe at this time we need a moratorium. We have to ban this. We should not allow creating genetically modified people, because it's just too dangerous and too unpredictable. But there's a lot of people --

15:36

(Applause)

15:37

Thanks.

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(Applause)

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And let me say, just as a scientist, it's a little bit scary for me to say that in public, because science generally doesn't like self-regulation and things like that. So I think we need to put a hold on this, but there are many people who not only disagree with me, they feel the exact opposite. They're like, step on the gas, full speed ahead, let's make designer babies. And so in the meeting in December and other meetings that are likely to follow in the next few months, it's very possible there may be no moratorium. And I think part of the problem that we have is that all of this trend, this revolution in genetic modification applying to humans, the public hasn't known about it. Nobody has been saying, look, this is a big deal, this is a revolution, and this could affect you in very personal ways. And so part of my goal is actually to change that and to educate and engage with the public and get you guys talking about this. And so I hope at these meetings that there will be a role for the public to bring their voice to bear as well.

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So if we kind of circle back now to 2030 again, that imagined story, and depending on the decisions we make, again, today -- literally we don't have a lot of time -- in the next few months, the next year or so, because this technology is spreading like wildfire. Let's pretend we're back in that reality. We're at a park, and our kid is swinging on the swing. Is that kid a regular old kid, or did we decide to have a designer baby? And let's say we went the sort of traditional route, and there's our kid swinging on the swing, and frankly, they're kind of a mess. Their hair is all over the place like mine. They have a stuffy nose. They're not the best student in the world. They're adorable, you love them, but there on the swing next to them, their best friend is a GM kid, and the two of them are kind of swinging like this, and you can't help but compare them, right? And the GM kid is swinging higher, they look better, they're a better student, they don't have that stuffy nose you need to wipe. How is that going to make you feel and what decision might you make next time?

18:08

Thank you.

18:09

(Applause)